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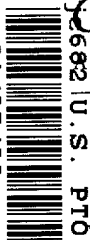
Via U.S. Express Mail EM419412724US

March 7, 2000

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Transmitted herewith for filing is the utility patent application of:
Inventors: B. Katzenberg and J. A. Deptula
For: Apparatus and Method for Remotely Powering Access Equipment Over a 10/100
Switched Ethernet Network
Co-Pending Provisional Application: 60/123,688 Filed March 10, 1999
Attorney's Docket: 19723-36396

Also enclosed are:

Three sheets of drawings   Assignment of the application
Declaration and Power of Attorney   Recordation Cover Sheet
Declaration of Small Entity Status (copy of previously filed)
Certificate of Mailing by Express Mail

CLAIMS AS FILED

Basic Filing Fee	$345.00
Total Claims: 9	
Claims in excess of 20: 0	0
Independent Claims in excess of 3: 0	0
Recordation of Assignment	40.00
Total Fee	**$385.00**

Enclosed is a check in the amount of $385.00 to cover these fees. The Commissioner is hereby authorized to charge any additional fees which may be required or credit any overpayment to Deposit Account 07-0045. A copy of this letter is enclosed for this purpose.

Yours very truly,

William C. Crutcher

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STATEMENT CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN	Docket Number (Optional) 19723-36396

Applicant, Patentee, or Identifier: __Katzenberg, et al.__

Application or Patent No.: __new__

Filed or Issued: _____

Title: __Apparatus and Method for Remotely Powering Access Equipment Over__ __a 10/100 Switched Ethernet Network__

I hereby state that I am

☐ the owner of the small business concern identified below:

☑ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN __Merlot Communications, Inc.__

ADDRESS OF SMALL BUSINESS CONCERN __4 Berkshire Boulevard__
__Bethel, Connecticut 06801__

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

☒ the specification filed herewith with title as listed above.

☐ the application identified above.

☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:

☒ no such person, concern, or organization exists.

☐ each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING __Ronald M. Keenan__

TITLE OF PERSON IF OTHER THAN OWNER __Chief Technology Officer__

ADDRESS OF PERSON SIGNING __10 Tilquist Road, Oxford, CT 06478__

SIGNATURE _____ DATE __3/9/99__

APPARATUS AND METHOD FOR REMOTELY POWERING
ACCESS EQUIPMENT OVER A
10/100 SWITCHED ETHERNET NETWORK

Cross Reference to Related Applications

5   This application claims the benefits of prior filed, co-pending application
Serial No. 60/123,688 filed March 10, 1999.

Field of the Invention

This invention broadly relates to the powering of 10/100 Ethernet compatible
equipment. The invention more particularly relates to apparatus and methods for
10   automatically determining if remote equipment is capable of remote power feed and
if it is determined that the remote equipment is able to accept power remotely then
to provide power in a reliable non-intrusive way.

Background of the Invention

A variety of telecommunications equipment is remotely powered today.
15   Telephones and Network Repeater devices are examples of remotely powered
equipment. Obviously there are many advantages to remotely powering equipment,
however this technique has not migrated to data communications equipment for
several reasons. Data communications equipment has traditionally required high
power levels to operate which has made it prohibitive to implement. The widely
20   distributed nature as well as the use of shared media used in data networks has
also made remote power impractical.

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The desire to add remotely powered devices to a data network is being pushed by the convergence of voice and data technologies. The advent of IP Telephony, Voice over IP and Voice over Packet technologies has brought traditional telephony requirements into the data environment. It is not desirable to

5   have a phone powered by a local wall transformer. It is desirable to have a centrally powered system that can be protected during a power outage.

It is therefore an object of the invention to provide methods and apparatus for reliably determining if a remote piece of equipment is capable of accepting remote power.

10   It is another object of this invention to provide methods and apparatus for delivering remote power to remote equipment over 10/100 switched Ethernet segments and maintain compliance with IEEE 802.3 standards.

Summary of the Invention

In accord with the objects of the invention an apparatus for remotely powering access equipment over a 10/100 switched Ethernet network comprises:

15   automatic detection of remote equipment being connected to the network; determining whether the remote equipment is capable of accepting remote power in a non-intrusive manner; delivering the power to remote equipment over the same wire pairs that deliver the data signals; automatic detection of remote equipment

20   being removed from the network.

The complete apparatus comprises a data node adapted for data switching, an access device adapted for data transmission, at least one data signaling pair connected between the data node and the access device and arranged to transmit data therebetween, a main power source connected to supply power to the data

25   node, a secondary power source arranged to supply power from the data node via

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the data signaling pair to the access device, sensing means for delivering a low level current from said main power source to the access device over the data signaling pair and sensing a resulting voltage level thereon, and control means responsive to said voltage level and adapted to control power supplied by the secondary power source to said access device in response to a preselected condition of the voltage level.

The method includes the steps of delivering a low level current from the main power source to the access device over the data signaling pair, sensing a voltage level on the data signaling pair in response to the low level current, and controlling power supplied by the secondary power source to the access device in response to a preselected condition of the voltage level.

Drawings

The invention will be more clearly understood by reference to the following description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a simplified schematic diagram of the remote power automatic detection system of the present invention, shown in conjunction with a single unit of remote access equipment connected as part of an Ethernet local area network,

Fig. 2 is a simplified schematic drawing of a power feed configuration for supplying power to the remote access equipment on the local area network, and

Fig. 3 is a simplified physical layout of a portion of a switched Ethernet network segment showing a telephone device powered through the network data carrying medium.

Description of the Preferred Embodiment

Referring now to **Fig. 1** of the drawing, a remote access device **10** which is compatible with 10/100 Ethernet requirements is connected through a data communications network interface adapter to a high data rate network cable **12**.

Remote access device **10** requires power to carry out its operation and includes an internal dc-dc switching supply which, in the absence of the present invention, would be supplied by an ac transformer adapter plugged in to the local 110 volt supply. Cable **12** is preferably Category 5 wiring such as 100BaseX suitable for 100 Mb/s data communications over a switched Ethernet network, and is connected to a port in a network data node **14**, such as a switch or hub.. Ethernet frames containing data are transmitted over cable **12** between node **14** and device **10**, and from node **14** to and from the network in accordance with selected protocols in a conventional manner known in the art.

In accordance with the present invention, a power source **16**, which may be the same as the conventional main power supply used to power the node **14**, is connected to cable **12** via lines **18** to supply a power level sensing potential to the remote access equipment **10** over one of the cable conductors. A return path from remote access equipment **10** is connected through a lead **20** to an automatic remote power detector, shown generally as **22**. Detector **22** includes an A/D converter and microprocessor control unit **24**, operating a detection circuit consisting of a resistor **26**, with shunting switch **28**, both connected in parallel to a resistor **30**, providing a path to ground. Switch **28** is actually an internal software controlled switch depicted diagrammatically as actuated by operator **32**.

Automatic detection of remote equipment being connected to the network is accomplished by delivering a low level current (approx. 20 ma) to the network interface and measuring a voltage drop in the return path. There are three states

4

which can be determined: no voltage drop, a fixed level voltage drop or a varying

level voltage drop. If no voltage drop is detected then the remote equipment does

not contain a dc resistive termination, and this equipment is identified as unable to

support remote power feed. If a fixed voltage level is detected then the remote

5   equipment contains a dc resistive termination (a "bob smith" is typical for Ethernet

terminations), and this equipment is identified as unable to support remote power

feed.

If a varying voltage level is detected, this identifies the presence of dc-dc

switching supply in the remote equipment. The varying level is created by the

10   remote power supply beginning to start up but the low current level is unable to

sustain the start up. This cycle continues to be repeated creating a "sawtooth"

voltage level in the return path. When this cycle is confirmed, switch S1 is closed

which increases the power output to the remote equipment. When the power to the

remote equipment reaches the proper level the remote power supply turns on and

15   the remote equipment becomes active. At this point a second, software level,

confirmation takes place. The remote equipment must respond to a poll using a

coded response with a unique MAC address. When this process is complete the

remote equipment is identified as known access equipment capable of accepting

remote power.

20   Referring now to **Fig. 2** of the drawing, a suitable remote power supply is

shown generally as **34**, which may be conveniently incorporated into an Ethernet 8

port switch card. A first center tap data transformer **36** includes a transformer

winding **38** with opposite ends connected by leads **40**, **42** to terminals **6, 3**

respectively of an RJ45 connector **43**. A second center tap transformer **44** with a

25   transformer winding **46** has its opposite ends connected via leads **48**, **50** to

terminals **2, 1** respectively of the connector **43**. Power feed is through a center tap

lead **39** and power return is through a center tap lead **45**. Inactive terminals **7, 8** of connector **43** are connected via lead **52** to a resistor **54**. Inactive terminals **1, 2** of connector **43** are connected via lead **56** to a resistor **58**. A junction between resistors **54** and **58** is connected to ground via a capacitor **60**.

5   Remote power is delivered to the remote equipment over the existing data signaling pairs (phantom power feed). Although it is typical that all 8 signal leads are delivered to remote equipment, only the 4 signaling leads are guaranteed in practice. See **Fig. 2** for the power feed configuration.

Once the remote equipment is operating and confirmed as a known remote
10   power enabled device, the logic circuit shown in **Fig. 1** begins to look for removal of the remote equipment or an overload fault condition. If the measured voltage level drops, then this indicates that the remote equipment has been removed and the logic circuit returns to the initial hunt state. If an overload condition is detected then the logic circuit returns to its initial state. It can then be programmed to
15   either wait for the fault state to be cleared or continue to cycle through the state machine.

Fig. 3 illustrates the physical layout of components corresponding to the schematic diagram of **Fig. 1**. The remote access equipment in this case is a telephone **62** equipped to handle data communications as well as voice and is
20   connected through an access node **64** to premises wiring **66**, comprising a Category 5 Ethernet 100BaseX cable of 4 sets of unshielded twisted pairs, which carry both data and power to the telephone **62**. Wiring **66** is connected to one of the ports of an 8 port Ethernet switch **68** which is powered from a main power supply **70**. The Ethernet switch card incorporates the automatic remote power
25   detector **22** discussed in **Fig. 1** and the remote power supply **34** discussed in **Fig. 2**.

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The power is provided over the wiring **66** both to the remote access node **64** and telephone **62**.

While there is disclosed what is considered to be the preferred embodiment of the invention, other modifications will occur to those skilled in the art.

Claims

1.   Apparatus for remotely powering access equipment in a data network, comprising:

a data node adapted for data switching,

an access device adapted for data transmission,

at least one data signaling pair connected between the data node and the access device and arranged to transmit data therebetween,

a main power source connected to supply power to the data node,

a secondary power source arranged to supply power from the data node via said data signaling pair to the access device,

sensing means for delivering a low level current from said main power source to the access device over said data signaling pair and sensing a resulting voltage level thereon, and

control means responsive to said voltage level and adapted to control power supplied by said secondary power source to said access device in response to a preselected condition of said voltage level.

2.   Apparatus according to claim 1, wherein there are at least two data signaling pairs connected between the data node and the access device to supply phantom power from the secondary power source to the access device, and wherein said access device includes a pair of data transformers having center taps connected for locally powering the access device.

3.   Apparatus according to claim 1, wherein said preselected condition comprises a varying "sawtooth"voltage level detected by said sensing means which causes said

control means to increase the power supply from the secondary power source to the access device.

4.   Apparatus according to claim 1, wherein the data node is an Ethernet switch card incorporating said secondary power supply, said sensing means and said control means.

5.   Apparatus according to claim 1, and further including a software program associated with said control means and arranged to poll the access device to identify itself and confirm that it is capable of accepting remote power.

6.   Method for remotely powering access equipment in a data network, comprising,

    providing a data node adapted for data switching, an access device adapted for data transmission, at least one data signaling pair connected between the data node and the access device and arranged to transmit data therebetween, a main power source connected to supply power to the data node, and a secondary power source arranged to supply power from the data node via said data signaling pair to the access device,

    delivering a low level current from said main power source to the access device over said data signaling pair,

    sensing a voltage level on the data signaling pair in response to the low level current, and

    controlling power supplied by said secondary power source to said access device in response to a preselected condition of said voltage level.

7.   Method according to claim 6, including the step of:

increasing power supplied to the access device in response to a "sawtooth" voltage level sensed on the data signaling pair.

8.   Method according to claim 6, including the step of polling the access device to identify it and confirm that it is capable of accepting remote power.

9.   Method according to claim 6, including the step of continuing to sense voltage level and to decrease power from the secondary power source if voltage level drops on the data signaling pair, indicating removal of the access device.

Abstract

Apparatus for remotely powering access equipment over a 10/100 switched Ethernet network comprises an Ethernet switch card with a phantom power supply for remote access equipment and added circuitry for automatic detection of remote equipment being connected to the network; determining whether the remote equipment is capable of accepting remote power in a non-intrusive manner; delivering the phantom power to the remote equipment over the same wire pairs that deliver the data signals, and automatically detecting if the remote equipment is removed from the network.
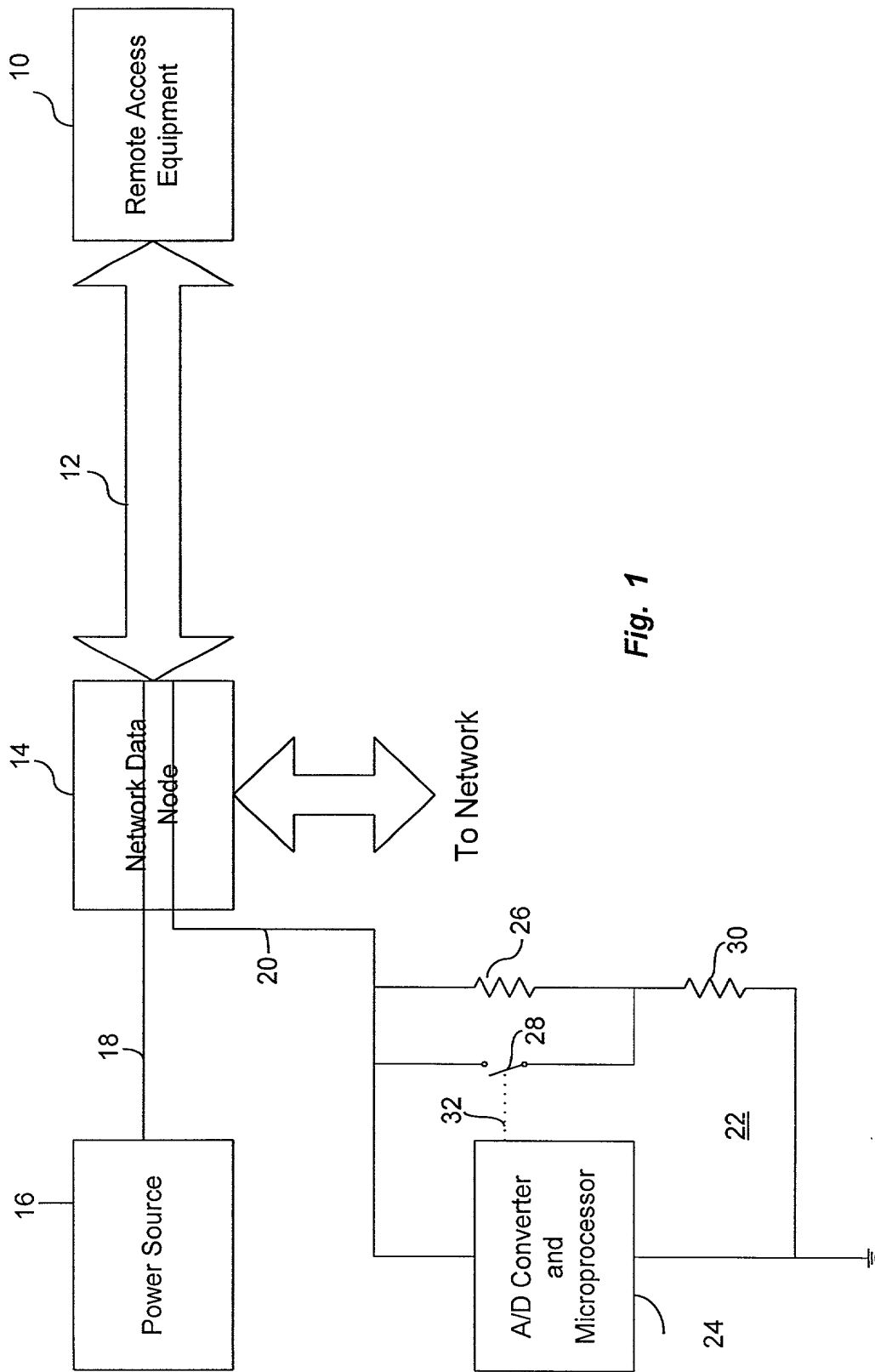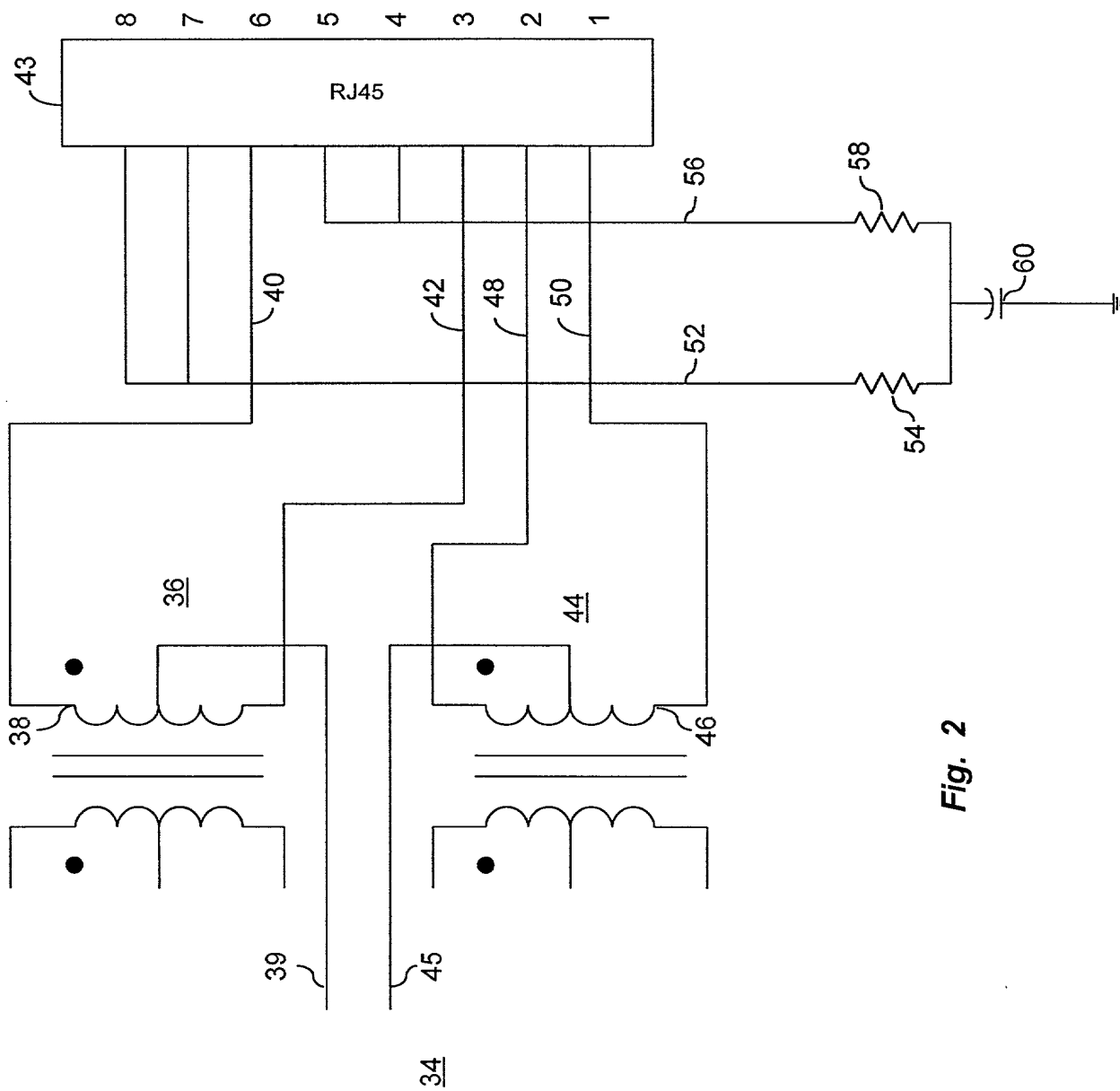
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Remote Access
Equipment

10

12

Network Data
Node

14

To Network

18

Power Source

16

20

26

28

32

30

22

A/D Converter
and
Microprocessor

24

Fig. 1

Fig. 2

Telephone

62

Data +
Phantom Power

Access
Node

64

Customers Desktop

66

Data +
Phantom Power

CAT-5 Ethernet
Premises Wiring

68

Main Power
Distribution bus

8-Port
Ethernet switches

Main Power
Supply

70

Backroom Common
Equipment

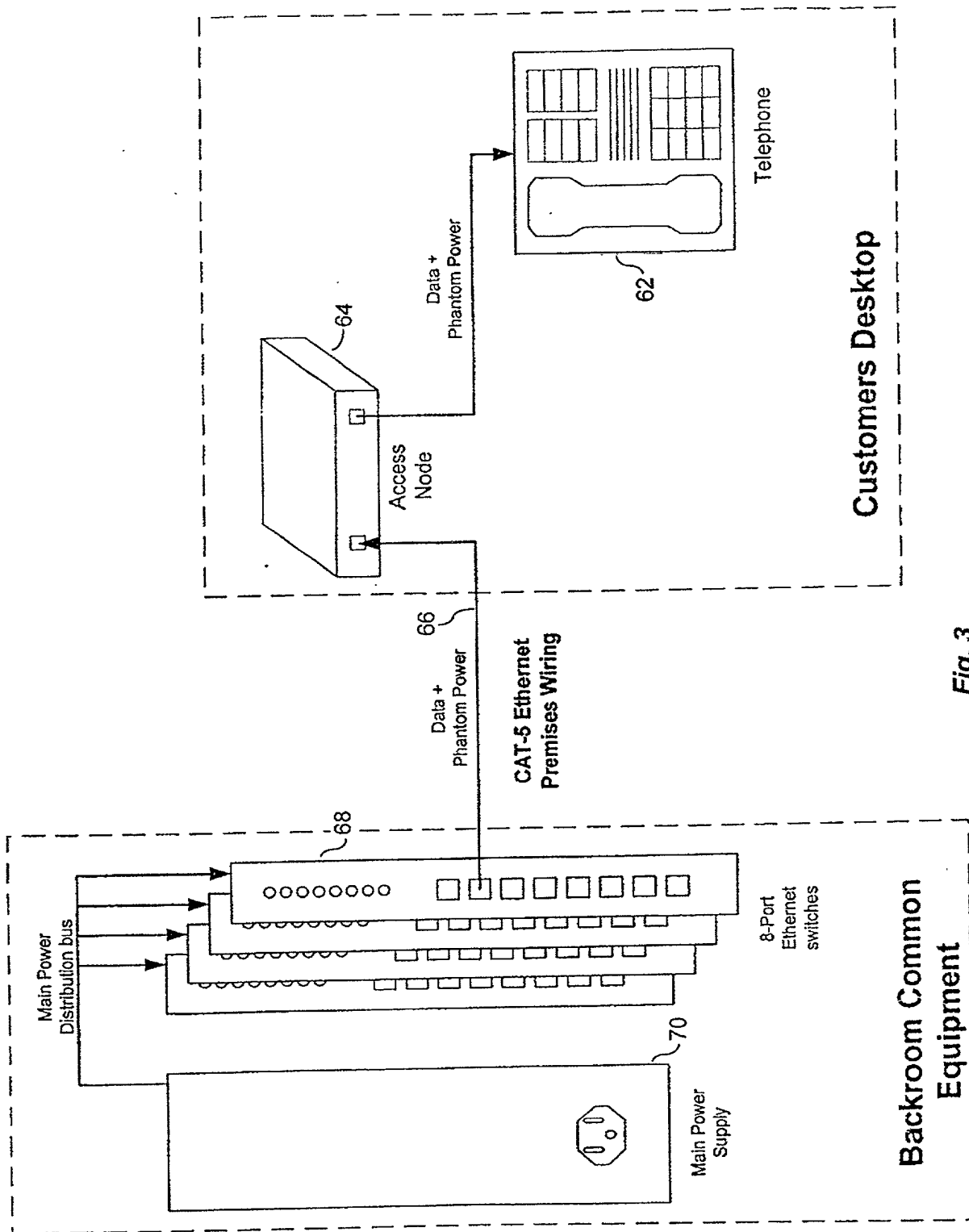*Fig. 3*

DECLARATION AND POWER OF ATTORNEY
UTILITY PATENT

As a below named inventor, I hereby declare that: my residence, post office address, and citizenship are as stated below next to my name and that I believe I am the original, first, and sole inventor (if only name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the invention entitled: **"Apparatus and Method for Remotely Powering Access Equipment Over a 10/100 Switched Ethernet Network"** which is described and claimed in the attached specification, and filed as provisional application no. 60/123,688 on March 10, 1999. I do not know and do not believe that the invention was ever known or used in the United States of America, or that the invention was ever patented or described in any printed publication in any country before my ___our _X_ invention thereof or more than one year prior to this application. I do not know and do not believe that the invention was in public use or on sale in the United States of America more than one year prior to this application. The invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a), and that no application for patent or inventor's certificate on this invention has been filed by me or my legal representatives or assigns in any country foreign to the United States of America except as follows:

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)   Priority Claimed

_____*(not applicable)*_____   [ ] [ ]
(Number) (Country) (Day/Mo./Yr. Filed)   Yes No

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of

the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

60/123,688	March 10, 1999	Pending
(Application Serial No.)	(Filing Date)	(Status)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

William C. Crutcher - Reg. No. 19,279

SEND CORRESPONDENCE TO: **DIRECT TELEPHONE CALLS TO:**

William C. Crutcher
Gager & Peterson, LLP   William C. Crutcher
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Waterbury, Connecticut 06722-2480

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: **Boris Katzenberg**
First inventor's signature: _____ Date: 3/6/2000

Residence: **48 Porters Hill Road, Trumbull, CT 06611** Citizenship: **U.S.A.**
Post Office Address: *(same as above)*

Full name of second joint inventor, if any: **Joseph A. Deptula**

Second inventor's signature: _____ Date: 3/6/00
Residence: **576 Mount Fair Drive, Watertown, CT 06795** Citizenship: **U.S.A.**
Post Office Address: *(same as above)*

FORM IN ACCORDANCE WITH 37 C.F.R. SECTION 1.63
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